Space Weather Technical Forecast

Issued on Tuesday, 29 November 2022 at 13:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Geomagnetic Storm intervals through the period. Chance of Active electron fluence 30th.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low in the past 24 hours, with a single C1 flare. There are currently two numbered sunspot regions on the visible disc, with AR3149 recently rotating out of view around the northwest limb. AR3151 is located close to the southwest limb and AR3152 is now centre disc in the northern hemisphere. Both regions appear relatively stable.

No new Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parameters, as measured by ACE and DSCOVR at L1, were indicative of positive coronal hole HSS influences, perhaps with some embedded CME influence. Solar wind speeds were initially strong, between 600-660 km/s before falling back to 520 km/s during the early hours of 29th. Wind speeds have since risen erratically to around 570-620 km/s. Density was around average or slightly above. The interplanetary magnetic field, IMF Bt, started moderate (9-10 nT) before gradually falling back to weak (5-6nT). The north south component followed a similar pattern but with the majority within the negative sector, ranging from +5 to -8nT, and with the largest fluctuations at the start of the period. The phi angle was predominantly positive (away from the Sun). Geomagnetic activity was initially Quiet (Kp 1-2) before becoming Unsettled to Active for the remainder of the period (Kp 3-4).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels. High energy electron flux (greater than 2MeV) at GOES16 was at Background to Moderate levels. Observed fluence at 29/0001 UTC was 4.87e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain Very Low over the forecast period, with a chance of isolated C-class flares, and just a very slight chance of isolated M-flares.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are expected during the period. Solar winds are currently elevated due to the connection to either CH48/+ or CH49/+. The next solar wind enhancement is expected either late on 30th Nov or early on 1st Dec due to the arrival of the HSS from CH51/+.

Geomagnetic activity is expected to be often Unsettled (Kp 3), with occasional Active (Kp 4) intervals, and a chance of isolated G1/Minor storm (Kp 5) intervals. The chance for G1 is greatest from late 30th or during 1st due to the arrival of the large CH51/+.

Energetic Particles / Solar Radiation: High energy electron flux (greater than 2 MeV), observed by GOES16, is expected to show a variable trend in coming days. Flux levels may become moderate or perhaps high for a time during 29th and 30th November before being suppressed by the high speed stream from coronal hole 51 from late 30th or during 1st for much of the remainder of the period. Toward the very end of the period, flux levels may once again

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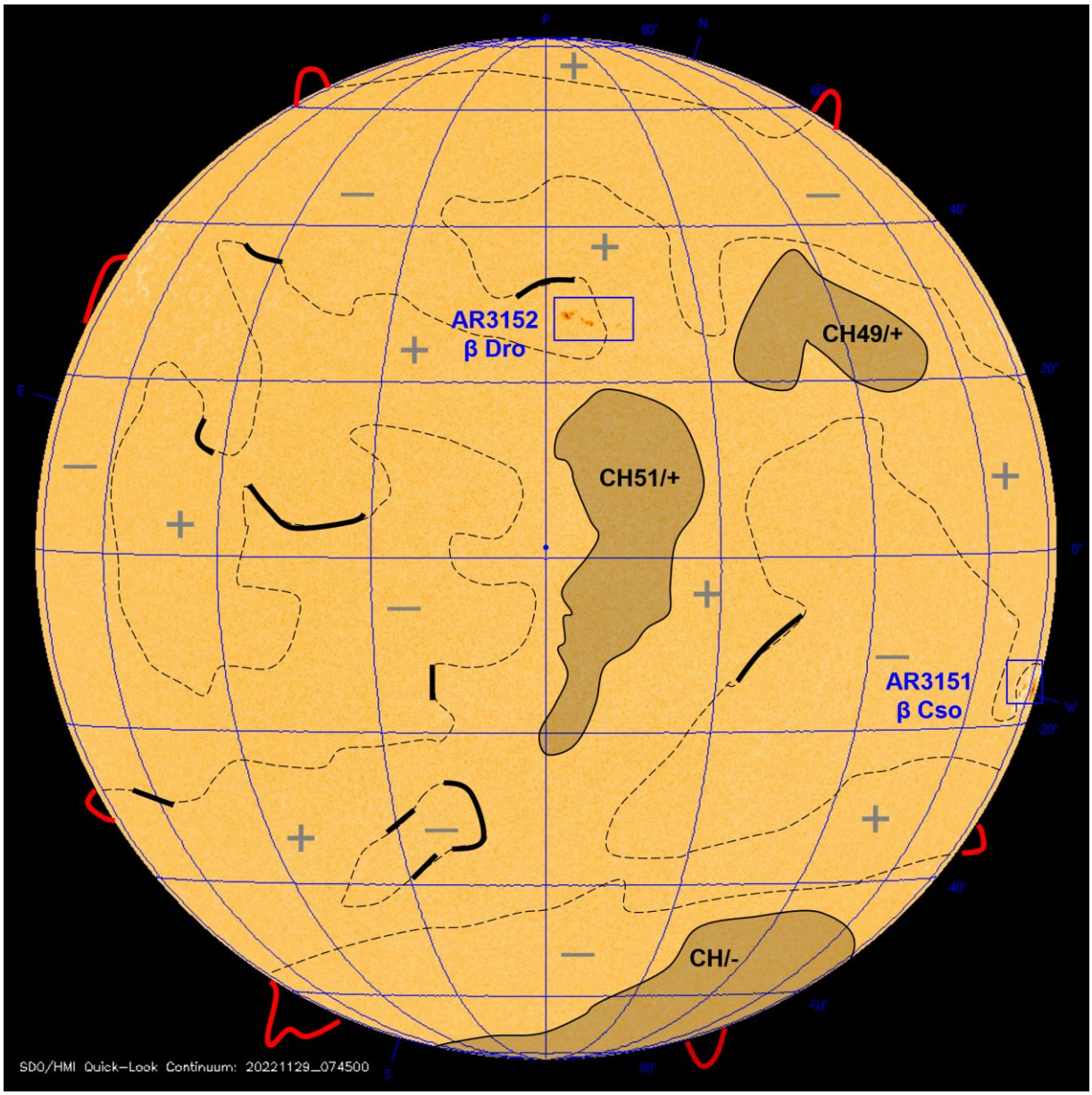
increase to moderate or high on the passing of coronal hole 51.

Fluence levels are well below the 1e8 integrated electron fluence active threshold, are on a slow but steady rise. An overall rising trend is probable through 29th and 30th, with a chance of reaching above the active threshold on 30th. However, given the likely arrival of coronal hole 51 late on 30th or on 1st, the risk of active electron fluence falls to a slight chance from 1st onward.

Figure 1. Solar Analysis Valid 29/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

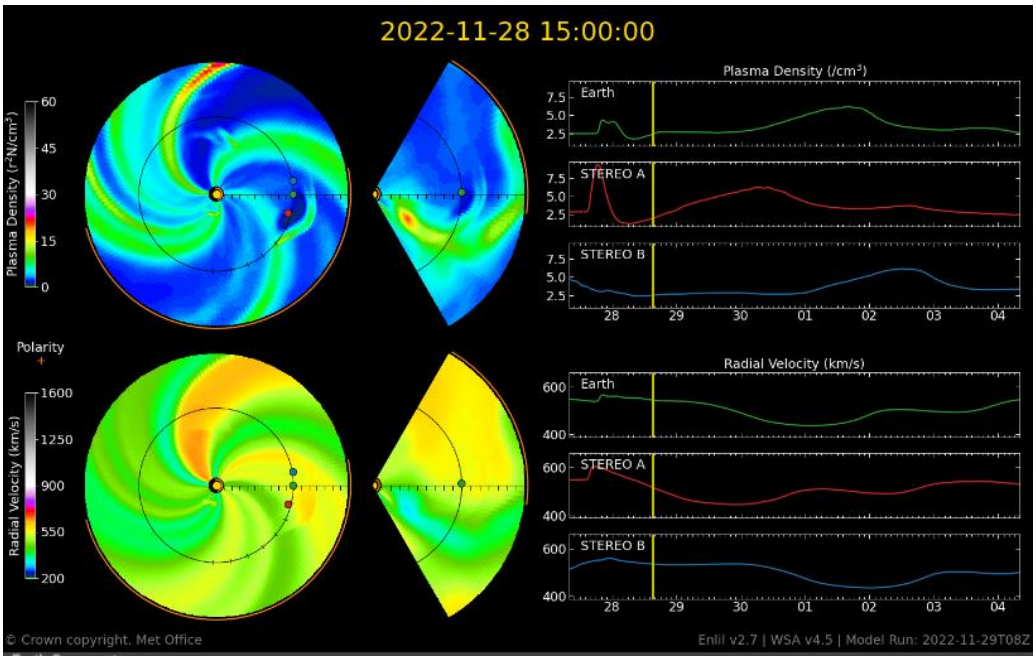
No Earth-directed CMEs are expected during the period.

Solar winds are currently elevated due to the connection to either coronal hole 48 or coronal hole 49. The next solar wind enhancement is expected either late on 30th Nov or early on 1st Dec due to the arrival of the high speed stream from coronal hole 51. This is a recurring feature, with solar winds peaking at around 550-600 km/s on the previous rotation. Similar, perhaps faster (550-650 km/s) solar winds can be expected due to the apparent increase in size and darkening of this of this feature on the SO-193 imagery.

Geomagnetic activity is expected to be often Unsettled, with occasional Active intervals, and a chance of isolated G1/Minor storm intervals. The chance for G1 is greatest from late 30th or during 1st due to the arrival of the large coronal hole 51/+.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	30	30	40	30
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC ENLIL



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Radio Blackouts - X-Ray Flares:

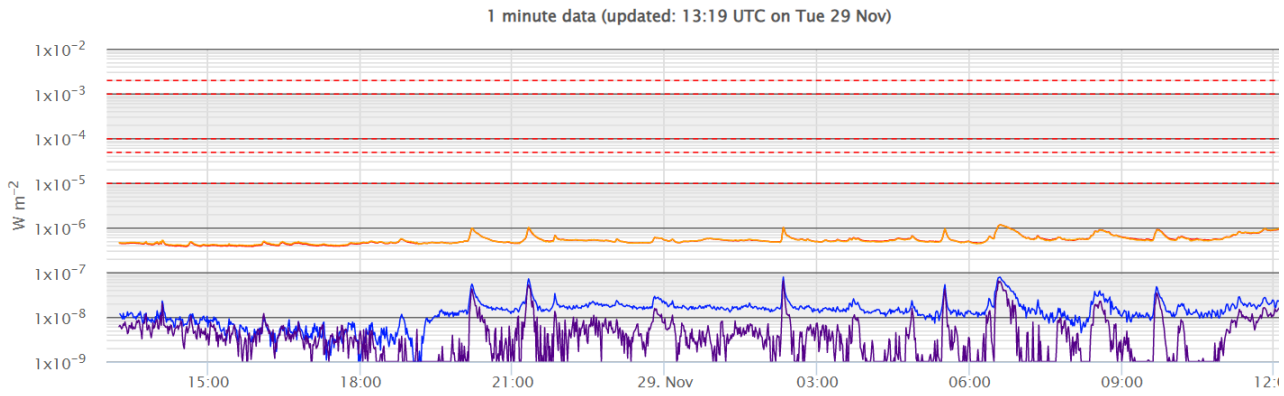
Solar activity is forecast to remain Very Low over the forecast period, with a chance of isolated C-class flares, and just a very slight chance of isolated M-flares.

There are currently two numbered sunspot regions on the visible disc, with AR3149 recently rotating out of view around the northwest limb. AR3151 is located close to the southwest limb and AR3152 is now centre disc in the northern hemisphere. Both regions appear relatively stable and small.

STEREO-A imagery doesn't currently show any significant bright flux regions just beyond the east limb, however far-sided seismic data gives the possibility of a couple of possible active regions returning around the east limb towards the end of the period. Probabilities are being maintained until these possible active regions emerge onto the visible disc.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-Ray trace past 24 hours



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV), observed by GOES16, is expected to show a variable trend in coming days due to the expected relaxing of the Van Allen belts post charging event from coronal hole 49. A recompression is then expected due to the arrival of coronal hole 51. This will likely allow flux levels to become moderate or perhaps high for a time during 29th and 30th November before being suppressed from late 30th or during 1st for much of the remainder of the period. Toward the very end of the period, flux levels may once again increase to moderate or high on the passing of coronal hole 51.

Fluence levels are well below the 1e8 integrated electron fluence active threshold, are on a slow but steady rise, also well below REFM and recurrence predictions. An overall rising trend is probable through 29th and 30th, with a chance of reaching above the active threshold on 30th. However, given the likely arrival of coronal hole 51 late on 30th or on 1st, the risk of active electron fluence falls to a slight chance from 1st onward.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	5	30	10	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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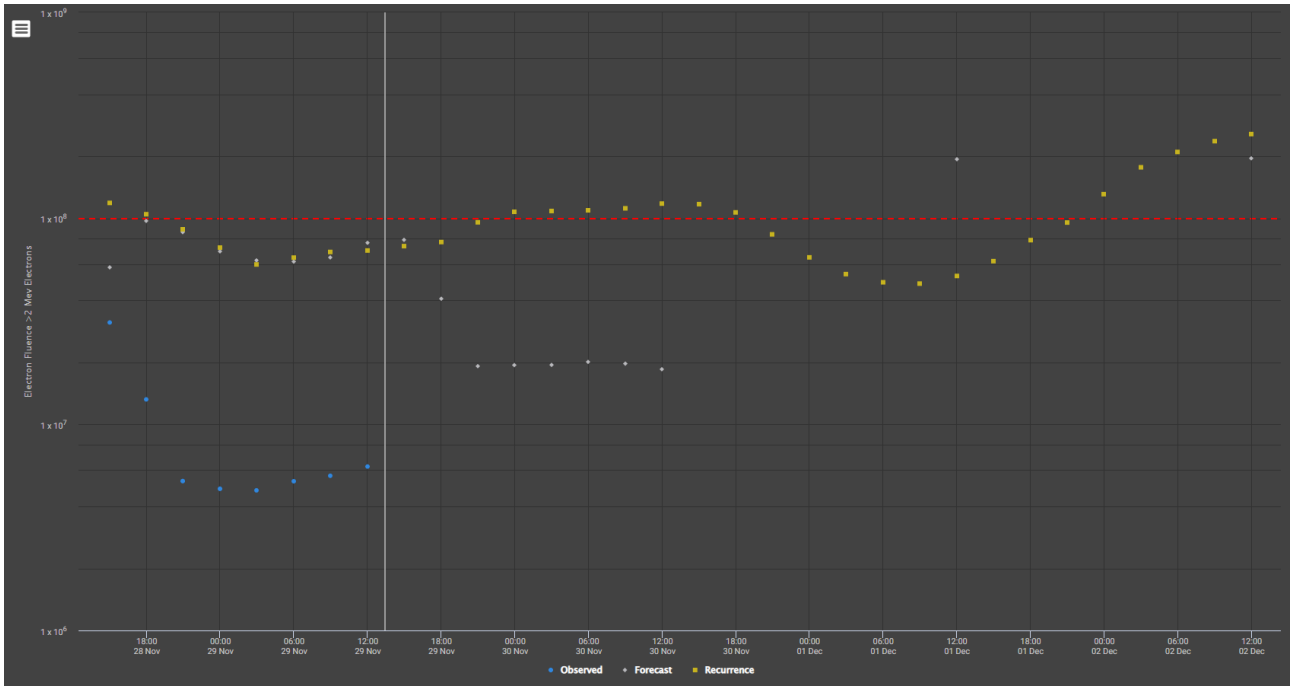
Figure 5: MOSWOC REFM integrated flux/fluence persistence, observations and model forecast.



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